Diabetes, Diversity, and Disparity: What Do We Do With the Evidence?

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The US Department of Health and Human Services has developed an initiative called "Eliminating Racial and Ethnic Disparities in Health," which parallels Healthy People 2010, the nation's health goals for the next decade. The initiative focuses on areas of health disparity that are known to affect racially and ethnically diverse groups of the population yet hold the promise of improvement.

The first step to addressing such health inequities is to understand the scope and nature of the diseases that contribute to such disparities. This commentary reviews the epidemiology and consequences of type 2 diabetes, particularly as it is manifested in socially and culturally diverse groups, and offers recommendations for actions to address the disparities resulting from diabetes. (*Am J Public Health.* 2002;92:543–548)

DIABETES MELLITUS REFERS to a group of metabolic diseases that are characterized by hyperglycemia. In turn, hyperglycemia is caused by the body's inability to produce or effectively utilize enough insulin, a hormone that the body uses to convert food into glucose. As a result of this defect, the level of glucose in the blood becomes elevated—a condition commonly referred to as high blood sugar. Diabetes mellitus is currently classified into the following 4 categories, based on etiology: type 1 diabetes, which is usually diagnosed in childhood or early adulthood; type 2 diabetes, which is diagnosed in middle or old age; gestational diabetes, which occurs during pregnancy; and other, less common types of diabetes that result from genetic defects, drug or chemical use, infections, or other diseases.[1]

The early symptoms of diabetes develop gradually and, as a result, often go unnoticed until serious damage has already been done to the body. Later symptoms or complications of the disease include neuropathy leading to ulcers and amputations, retinopathy leading to blindness, nephropathy leading to renal disease, atherosclerotic cardiovascular disease, peripheral vascular disease, cerebrovascular disease, hypertension, increased susceptibility to infections and prolonged recovery time, and lower-extremity amputations.[2]

Diabetes is a costly disease. One out of every 7 dollars spent on medical care in the US is related to diabetes,[3] with an annual cost of over $100 billion, and diabetes accounts for more than 3 million hospital stays and more than 15 million physician visits each year.[4,5] Although the majority of adults with diagnosed diabetes attempt to control the disease, they are substantially less healthy than nondiabetic adults. In addition to being at risk for diabetic complications, diabetics are at higher than average risk for comorbid health conditions, disability, depression, cognitive impairment, and poor quality of life. Diabetics also have higher rates of disability—almost 30% of those aged 45 to 60 years and over 45% of those 70 years and older report some form of disability, compared with only 10% to 20% of nondiabetics.

THE SCOPE OF DIABETES

Diabetes can appear at all ages and in all ethnic groups and has been found in virtually all parts of the world. Indeed, from a global perspective, diabetes has become an epidemic: more than 150 million adults worldwide suffer from diabetes, a figure that is expected to double over the next 25 years.[6] Diabetes is strongly associated with socioeconomic transition; the prevalence of diabetes in the developed countries (6.2%) is almost double that in the developing countries (3.5%). Furthermore, the increase in prevalence of diabetes over the next 25 years will be much greater in the developed countries, which will experience a 170% increase, compared with a 42% increase in the developing countries.

The United States has the largest number of diabetics of all the developed countries, with more than 16 million currently suffering from the disease.[1] Over the past 40 years, the prevalence of both diagnosed and undiagnosed diabetes in the United States has increased dramatically, as has the prevalence of impaired fasting glucose and impaired glucose tolerance, both precursors of diabetes. By 2025, an estimated 22 million Americans will have diabetes.[6] Approximately 90% of these will be type 2 diabetics, including almost 6 million who will be undiagnosed.

Although diabetes can affect any segment of the population, the disease is especially burdensome among certain groups, particularly African Americans, Hispanic Americans, Native Americans, the elderly, those of the lower socioeconomic classes, and women.[7] These groups are also least likely to receive timely and adequate health care; among them, as a result, diabetes is somewhat of a hidden disease. For women in particular, diabetes can have devastating effects on health. Diabetes effectively eliminates the protection that women generally experience against coronary heart disease, because hyperglycemia and hyperinsulinemia undermine the protective effects of estrogen.[8–10]

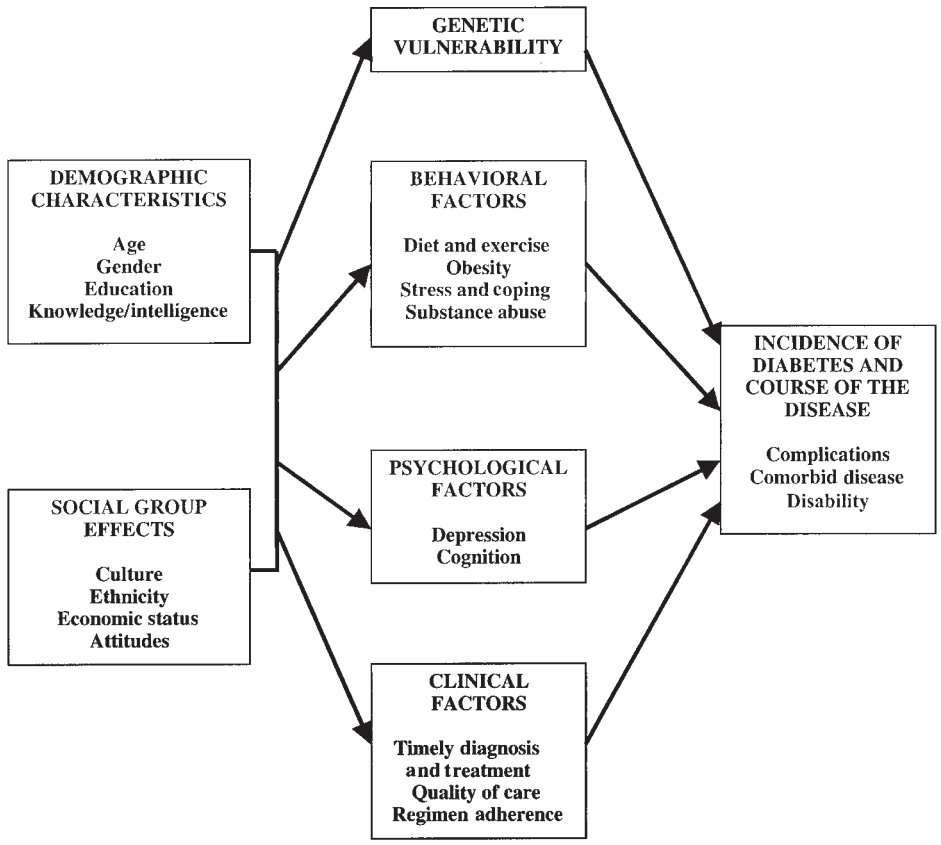

FIGURE 1—Conceptual framework of risk factors for the development of diabetes.

This commentary focuses on the epidemiology, risk factors, and outcomes of type 2 diabetes in the United States, with a particular focus on the impact of social and behavioral factors not only among women but among all groups at elevated risk.

RISK FACTORS

The myriad risk factors that influence the development and course of diabetes are illustrated in Figure 1. Foremost among these is genetic vulnerability: family history of diabetes is the strongest predictor of developing diabetes, particularly when the disease is present in first-degree relatives. Other factors include demographics, social group characteristics, behavioral and lifestyle influences, psychological factors, and clinical factors, such as adequate medical care and adherence to treatment regimes. Many of the strongest risk factors are especially influential among women of color, as can be seen in Table 1.

Age

The risk for diabetes increases dramatically with age.[1] Although adults 65 years and older currently compose about 12% of the general population, they account for more than 40% of diabetics. This is particularly important when considering future population trends. Over the next two to three decades, the number of older adults will increase dramatically, to more than 20% of the population.

Ethnicity

Diagnosed diabetes is present in about 7% of all adults 45 years and older; however, the rates vary substantially by ethnicity.[11] Data from the Third National Health and Nutrition Examination Survey and the Hispanic Health and Nutrition Examination Survey indicate that among adults aged 40 to 74 years, the prevalence of *diagnosed* diabetes is about 7% for non-Hispanic Whites, 12% for African Americans, and 14% for both Mexican Americans and Puerto Ricans.[2,12] Among the various Asian American and Pacific Islander groups, the rates of diabetes vary substantially but can be as high as 15% to 20%.[11] The highest rates are experienced by Native American tribes in the Southwest, with an estimated prevalence of more than 37%.[13] Indeed, the highest prevalence of diabetes in the world (50%) is experienced by the Pima Indians of Arizona.[11,14]

Diabetes is often undiagnosed in the adult population, because type 2 diabetes is generally asymptomatic in its early stages and without regular screening goes undetected. The prevalence of *undiagnosed* diabetes has been estimated to be about 6% for non-Hispanic Whites, 7% for African Americans, 10% for Mexican Americans, 12% for Puerto Ricans, and as high as 15% for Native Americans.[2,12,13] These large percentages of undiagnosed diabetes show not only that the burden of diabetes is much greater than is indicated by the statistics for diagnosed disease but also that the unrecognized burden is greatest among the non-White culturally diverse groups.

It is significant that non-White populations not only experience higher prevalence of type 2 diabetes but also suffer from more frequent complications and greater disease severity. Studies of older adults with diabetes have shown that both Mexican Americans and African Americans experience a greater burden from diabetes than do older non-Hispanic Whites.[15,16] This is particularly evident with regard to mortality resulting from diabetes. Overall age-adjusted death rates from diabetes are about 10% for non-Hispanic Whites, 20% for Hispanic Americans, and 30% for African Americans and Native Americans.[5] These differences are even more apparent when one compares the rates of diabetes across the older ages. Among non-Hispanic Whites, the prevalence of diabetes is about

TABLE 1—Risk Factors for Type 2 Diabetes Mellitus

	Major Risk Factors
Genetics	Family history of diabetes (especially parents or siblings)
Race/ethnicity	African American, Hispanic American, Native American, Asian American, or Pacific Islander
Obesity	BMI of ≥27; ≥20% over desired body weight
Age	≥45 years
Hypertension	Blood pressure >140 systolic or >90 diastolic
Elevated cholesterol	HDL >35 mg/dl or triglyceride level >250 mg/dl
Gestational diabetes	History of gestational diabetes or having given birth to a baby weighing >9 pounds
Impaired glucose tolerance	Previously identified plasma fasting glucose of 110–125 mg/dl
Impaired fasting glucose	Previously identified plasma fasting glucose of <140 mg/dl and 2-h plasma glucose of 140–199 mg/dl
	Secondary Risk Factors
Sex	Female
Education	<High school education
Income	Limited income or poverty
Sedentary lifestyle	Inadequate exercise or physical activity

Source. American Diabetes Association, 2000.
Note. BMI = body mass index; HDL = high-density lipoprotein.

10% both for adults aged 65 to 74 and for those 75 years and older. In contrast, the rate of diabetes among African Americans drops from 20% among adults aged 65 to 74 years to only 14% among those 75 and older.[12] Similarly, the rate of diabetes among older Mexican Americans drops from 25% among adults aged 65 to 74 years to 18% among those 75 to 84 years to only 12% among those 85 years or older.[16] These decreasing prevalence rates reflect increased mortality among African American and Mexican American diabetics in the earlier years of old age.

Socioecomonic Status

The socially and economically disadvantaged are also at elevated risk for diabetes.[17] Forty percent of adults with diabetes have less than a high school education, compared with only 20% of the general population. Diabetics tend to earn less, with a median individual annual income of $9,550, compared with $20,125 among nondiabetics.[18] In addition, whereas the majority of individuals with type 2 diabetes are employed, a sizeable proportion are unemployed. Among adults aged 45 to 64 years, for example, 49% of diabetics are unemployed, compared with only 28% of nondiabetics.

Socioeconomic inequalities in health have been attributed to a variety of mechanisms that may act as intermediate risk factors for diabetes.[19] These include poor nutrition, overweight, increased rates of poor health behaviors such as smoking and alcohol consumption, stress, and limited access to health care, particularly in middle age when many individuals are at highest risk for developing diabetes.[20] Access to adequate health care plays an even stronger role in controlling diabetes, preventing the development of complications, and avoiding diabetes-related mortality.[21] Low socioeconomic status may also influence the development of diabetes as a result of inadequate maternal nutrition during and even prior to pregnancy.[22]

Psychological Factors

Stress can impair glucose tolerance even in nondiabetics.[23] Stress and psychological distress also have negative influences on glycemic control once diabetes has developed.[24–26] Diabetics are more likely than nondiabetics to experience clinical depression,[27,28] and even when clinical depression is not present, diabetic adults are more than twice as likely to manifest substantially higher rates of depressive symptoms and other signs of psychological distress. Depressed diabetics are more likely to develop diabetic complications, comorbid chronic health conditions, and disability than nondepressed diabetics and are as much as 4 times more likely to die prematurely.[29,30] Depressed diabetics are less motivated to adhere to treatment regimes, are less socially and physically active, and report less life satisfaction and hope regarding the future. This interaction intensifies the effects of both diabetes and depression, resulting in increased use of health care services, more frequent and lengthier hospitalizations, and greater costs associated with care.[31] Depression has also been linked to the development of diabetes and is also more highly prevalent among the lower socioeconomic groups.[32–34]

Sex

In most populations, the prevalence of diabetes is comparable for both sexes; however, among women, the disease generally has a more devastating impact and is more difficult to control. This is most striking among African Americans and non-Hispanic Whites, moderate among Mexican Americans, and almost nonexistent among Puerto Ricans and many Native American tribes.[35] It is thought that much of this difference between the sexes results from varying rates of obesity, physical activity, and hormone action among women.[12] In addition, certain sociocultural factors, such as the role that women play in the family, may affect women's vulnerability to diabetes. Women are often the keepers of culture, the family members who pass on cultural practices, such as what foods are served for holiday celebrations or what activities family members are encouraged to engage in. This responsibility to maintain cultural practices and pass them on to younger generations can make it difficult for a mother or grandmother to successfully make lifestyle changes.

Women also suffer from gestational diabetes, or glucose intolerance that begins during pregnancy. Gestational diabetes complicates about 5% of all pregnancies, but the rate of occurrence can range up to 14% depending on the population subgroup.[36] When left untreated, gestational diabetes harms both the mother and infant, often resulting in chronic hypertension as well as perinatal morbidity and mortality. Gestational diabetes is most likely to occur among women older than 25 years, those who are obese, those with a family history of diabetes, and those who are members of the ethnic groups at higher risk for diabetes in general—African

Americans, Native Americans, Mexican Americans, Asian Americans, and Pacific Islanders.[37–39] Although most women with gestational diabetes regain their normal health in the months following delivery, they remain at elevated risk for developing type 2 diabetes later in adulthood. Only about 5% of women with gestational diabetes develop type 2 diabetes within 6 months of delivery; however, 40% to 50% develop diabetes after 15 years, particularly among non-White women.[37]

Many of the risk factors for diabetes have a greater impact among women than among men; the inverse relationship between socioeconomic status and type 2 diabetes is stronger among women, regardless of ethnicity.[19] In NHANES III, both African American and non-Hispanic White women with household incomes below the poverty line had more than twice the risk of developing diabetes as did women with twice the poverty level, even when other risk factors such as body weight, diet, physical activity, and the use of tobacco and alcohol were controlled for.

Lifestyle

The risk of developing type 2 diabetes also increases with body weight and sedentary lifestyle. The majority of type 2 diabetics are obese and physically inactive.[7,40] More than 45% of adults with type 2 diabetes have a body mass index of at least 30.[2] Obesity itself causes some level of insulin resistance,[41] and even many diabetics who are not obese have an increased percentage of abdominal fat.[42] This is a particular problem for many non-White adults.[43,44] Numerous studies have demonstrated that Mexican Americans and African Americans have higher insulin concentrations, greater insulin resistance, and lower insulin sensitivity than do non-Hispanic Whites with comparable body mass indexes and waist–hip ratios.[45,46]

Obesity is also more of a problem for women than for men: for adults 25 years and older, the prevalence of obesity is 21% among men and 27% among women.[47] Among the non-White culturally diverse groups, the prevalence of obesity is 13% higher among African American women than among African American men and 18% higher among Mexican American women than among Mexican American men.[19,47] Obesity is also strongly related to a striking new epidemic of juvenile onset of type 2 diabetes, particularly among non-White culturally diverse groups.[48,49] Type 2 diabetes has generally been diagnosed in adults 45 years or older; however, it is being seen increasingly in younger adults and children, a direct result of increasing rates of obesity and physical inactivity.

Other lifestyle factors that are related to the development of diabetes include smoking, alcohol consumption, poor diet, and, most important, inactivity. Inadequate physical activity or exercise is well recognized as a risk factor for diabetes. In addition to contributing to the development of obesity, a sedentary lifestyle worsens insulin sensitivity and results in elevated blood glucose levels.[1] Exercise not only improves glycemic control among diabetics; it can also help to prevent many of the complications of the disease, including cardiovascular disease, hypertension, and hyperlipidemia. Women are at greater risk for inactivity, particularly as they age. African American and Mexican American women are also more likely than non-Hispanic White women to be physically inactive.[50]

Women, then, appear to have only slightly elevated risk for diabetes based purely on their sex. They are at substantially elevated risk, however, for many of the other risk factors for diabetes, including low socioeconomic status, obesity, inactivity, and gestational diabetes. In addition, women are more likely to reach advanced age than men.[51] It is not surprising, then, to find that women, particularly women of color, also often suffer a greater burden from diabetes.

WHAT DO WE DO WITH THIS EVIDENCE?

First and foremost, *diabetes must be acknowledged as a public health problem*, one that affects all groups of all ages and that has reached epidemic proportions. A recent report from the Heart Outcomes Prevention Evaluation Study indicates that the development of much of type 2 diabetes and its complications can be delayed or even totally prevented.[52] Treatment and prevention efforts should be approached not only on the level of an individual health problem but, even more, as a public health issue.[53,54] Community interventions, including early screening and lifestyle change, are paramount and must be culturally appropriate.

Second, *effective treatment and prevention programs must become standard clinical practice.* Intensive diabetes management and improved glycemic control are the keys to minimizing the impact of diabetes and would lead to fewer medical costs, lower rates of complications, and greatly reduced mortality as a result of the disease.[52] It has been noted that a reduction of just 10% in the average blood glucose levels of all diabetics would result in a 40% decrease in the rate of diabetic complications and associated health care costs.[55] Indeed, intensive therapy for diabetes has been shown to reduce the occurrence of retinopathy and blindness by over 40%, lower-body amputations by over 40%, and end-stage renal disease by over 70%.[56] Despite the development of effective treatment and preventive programs, however, evidence suggests that they are not widely used in daily clinical practice.[57–59] Non-White culturally diverse groups and women are at particularly high risk for poor glycemic control resulting from less than adequate preventive care services.[2,53] Both of these groups are also less likely to engage in adequate self-care practices, particularly self-monitoring of blood glucose levels.

Third, *screening and interventions in the prediabetic years must become the norm.* We need to increase screening among high-risk groups and institute culturally appropriate interventions that will enhance change in the prediabetic years, particularly early adulthood. These interventions should target lifestyle changes—in particular, proper diet and adequate exercise. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus and the American Diabetes Association[1] recommend that all people 45 years or older should be tested for diabetes, regardless of the presence or absence of other risk factors for the disease, and that testing should be repeated every 3 years. Individuals at

higher risk should begin being tested at younger ages and be tested at more frequent intervals.

Finally, *those groups at highest risk must be empowered to take control of their own health.* It is clear that several subgroups of the population are at particularly high risk for diabetes. These include members of most non-White culturally diverse groups but particularly African Americans, Mexican Americans, Puerto Ricans, and Native Americans. The high-risk subgroups also include individuals with a family history of diabetes, the poor and uneducated, older adults, the obese and sedentary, and women, particularly those who are members of non-White culturally diverse populations or those with a history of gestational diabetes.

Control of diabetes is a highly demanding endeavor, requiring substantial vigilance, lifestyle change, medication adherence, and motivation. Those who suffer most from the disease are often those least prepared to deal with it. This means that early detection and increased awareness of diabetes, while important, are not sufficient. All people at risk for diabetes must be helped to develop the skills necessary to prevent or manage the disease. ■

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